# MATERIALS PROCESSING

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## DESIGN AND EFFICIENCY OF SECTIONAL LARGE-DIAMETER DIAMOND WHEELS

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This paper considers the design and industrial application of a circular grinding wheel of diameter 600 mm based on a multiple-use body with a groove along its diameter in which special elements are fastened. These elements are based on a binder with a diamond-bearing surface layer and are shaped as overlapping parallelepipeds with a clearance between the cutting layers of the elements.

The grinding of forming disks made of glass, glass ceramics, or another brittle material on circular grinders 3B-151, 3B-161 and their analogs is performed using grinding wheels of form 1A1 on binder M2-01 and other wheels satisfying the standard requirements (GOST 16167–90).

The wheels, up to 500 mm in diameter produced by molding, have a six-millimeter diamond-bearing layer; the powder weight is 655 – 1960 carats for a concentration of 50 – 150%. The estimated specific consumption of synthesized diamond AS15 with grain size 315/250 – 100/80 in rounding is 1.5 carats/dm$^3$ (OST 3-6324–87) [1] and is corroborated by long-term industrial service of the tool.

Large-size wheels were produced by the galvanic method with diamond layer thickness 0.5 – 1.5 mm according to the technical specifications of the company. Breaking in or running in wheels, as well as technological waste, decreases the diamond utilization efficiency, since the specific consumption of diamond in a galvanically produced wheel is twice as high as in a molded wheel.

A sectional diamond wheel (USSR Inventor's Certif. No. 1646824) whose design in shown in Fig. 1 has been developed for large-diameter circular tools produced by molding. A groove of a particular configuration is turned along the generating line of body *1*. Elements *2* with corresponding radii of the fitting part and the diamond-bearing working part *3* are in turn inserted into the groove via the inlet opening. Before assembly, an adhesive is applied to pretreated contact surfaces of the body and the elements. After filling the groove, the inlet opening is covered with lid *4*. The tool is installed on a circular grinder and given a rotational speed providing the force that is required for joining the elements to the body and to each other, taking into account the properties of the adhesive used. Some more adhesive is added during its shrinkage and complete solidification, and the wheel undergoes balancing, dressing, and other standard operations.

The sectional grinding wheels that has been produced and implemented in industrial conditions are characterized by the following technical solutions:

– the turned groove in the body and the fitting part of the element both have a "swallow-tail" shape;

– the element bodies made of a binder with a diamond-bearing surface are molded and fired simultaneously;

– the number of elements is 12 – 18 for wheels of diameters 400 – 600 mm, respectively;

– the total working surface has a clearance of 2.0 – 2.5 mm in the diameter and up to 1.0 – 1.5 mm into the depth of the diamond-bearing layer and is shaped as a parallelepiped with its corners oriented toward the generating line, which ensures their mutual overlapping (USSR Inventor's Certif. Nos. 200461 and 356115).

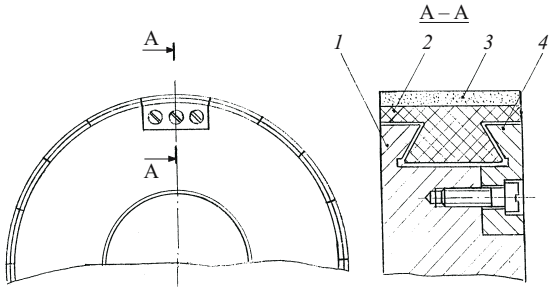


**Fig. 1.** Drawing of a sectional diamond wheel.

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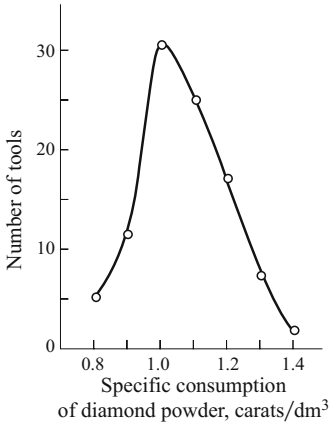


**Fig. 2.** Normal distribution curve of specific consumption for diamond powder AS15 of grain size 315/250 – 160/120 and 100% concentration based on binder M2-1 using a sectional wheel of diameter 600 mm.

The sectional design offers the following options:

– multiple use of the wheel body;

– varying the grades, grain sizes, and concentrations of diamond powders, binders, and working surface shapes depending on particular purposes;

– simple solutions for further strength increase and improving the quality of treatment due to variable-length protrusions and hollows (USSR Inventor's Certif. Nos. 580108 and 901043).

In industrial conditions glasses K8 and tinted glasses have been treated using straight-profile wheels based on synthesized diamond powder AS15 of grain size 315/250 – 160/120, concentration 100%, and binder M2-1. The analysis of the performance of 54 tools is presented in Fig. 2. The average specific consumption is 1.07 carats/dm$^3$, which is 29% lower than the standard norm and correlates with the data in [2] obtained in the decorating treatment of crystal glass using a small-size tool A2P of diameter 100 mm (diamond powder ASV, grain size 50/40, concentration 50%, binder M1), in which rectangular-profile radial grooves were made to a depth equal to that of the diamond-bearing layer.

## REFERENCES

1. *Diamond Abrasive Tools. Generalized Consumption Standards* [in Russian], VNIITÉM, Moscow (1989).
2. Yu. Ya. Kumysh and V. R. Kangun, "Efficiency of using diamond wheels in treatment of crystal glass articles," *Steklo Keram.*, No. 2, 29 – 30 (1982).